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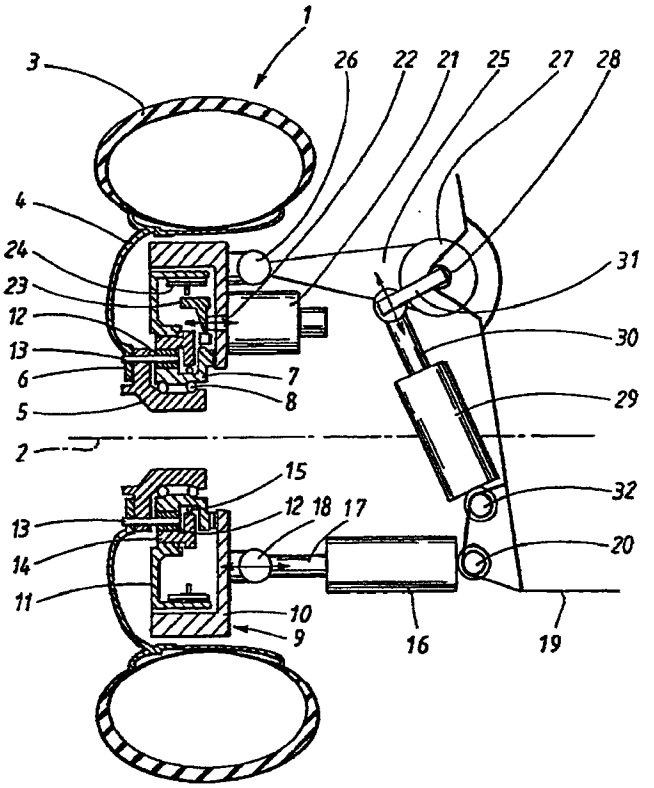
(54) Title: WHEEL SUSPENSION ARRANGEMENT IN A VEHICLE

(57) Abstract

The invention is directed towards an arrangement for the suspension of a wheel (1) of an automotive vehicle, said wheel (1) being connected to a propulsion device (9) for driving the vehicle and a braking device (21) for braking each individual wheel (1). The invention is characterised by comprising sensors (37, 38, 39) for detecting at least the angular steering displacement of the vehicle required by the vehicle driver, two steering link arms (16, 16') fitted between said body (19) and attachment points (17, 17') in said wheel (1), positioned on both sides of an imaginary vertical line (33) running through the centre of the wheel (1), and a control unit (36) for processing signals from said sensors (37, 38, 39) and for actuating said steering link arms (16, 16') for adjustment of said wheel (1) in response to said signals and the current operating state of the vehicle. Through the invention, an improved, integrated wheel suspension unit for automotive vehicles is provided, particularly allowing dynamic wheel alignment adjustment and adjustment of the angular steering displacement of each individual wheel (1) of the vehicle.



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TITLE

Wheel suspension arrangement in a vehicle

TECHNICAL FIELD

The present invention relates to a vehicular wheel suspension arrangement in accordance with the accompanying claim 1. The invention is in particular intended for use as an integrated wheel suspension unit for steering, propulsion and braking of the respective wheel of an automotive vehicle.

BACKGROUND ART

In association with vehicles, e.g. passenger cars, various types of suspension systems are used today for the vehicle wheels and wheel axles. Such wheel suspensions are, in a known manner, arranged for allowing attachment and resilient suspension of the vehicle wheels, in turn aiming at good comfort for the vehicle passengers and enhancing the road holding properties and the service life of the vehicle.

A multitude of different types of wheel suspension are previously known, and comprised in systems with e.g. rigid or split wheel axles, which may, according to requirement, be supplemented by spring members, shock absorbers and other components. Besides that, force-absorbing link arms connecting the vehicle wheels to its body, and anti-roll bars for reduction of excessive rolling motions of the vehicle, are often utilised.

Further, today's vehicles are normally often designed such that the vehicle motive wheel axles are connected to an engine, for example consisting of a conventional combustion engine of the Otto or Diesel type. The connection between the wheel axles and the engine is then arranged via a gearbox and mechanical transmission devices. Furthermore, the vehicle wheels are provided with braking devices, such as conventional disc or drum brakes, actuated in a known manner by depression of the vehicle brake pedal. In this way, the brake devices at the wheels are actuated via a hydraulic brake line system.

Also, today's vehicles are normally provided with a steering device intended for giving the wheels a certain angular steering displacement when the driver is turning the vehicle steering-wheel. A known type of steering gear comprises an input shaft, to which the steering-wheel is connected, said shaft transmitting the steering-wheel movements to a pinion that in turn is connected to a rack. The rack movements are in turn transferred to the vehicle wheels, for steering the vehicle. Such a known steering gear may be complemented by a servo power device, comprising a hydraulic cylinder with a piston arranged on the steering rack. In this way, more power may be applied onto the rack when turning the steering-wheel.

The equipment described above for propulsion, wheel suspension, braking and steering is based on well-proved principles that are frequently used today in automotive vehicle design. Although these principles define a well functioning technique, they exhibit certain limitations. For example, it may constitute a problem that all the components mentioned above (i.e. engine, gearbox, transmission, spring arrangement, anti-roll bars, brakes, steering, etc.) have to be fitted into a relatively small space in the vehicle. Furthermore, there may be a difficulty in interconnecting, in a cost-effective and secure manner, a large number of functions associated with a wheel suspension system. Especially, there may exist, in some cases, a requirement for a high degree of integration of vehicle functions for suspension and propulsion of the respective wheel.

DISCLOSURE OF INVENTION

The object of the present invention is to provide an improved vehicular wheel suspension arrangement, which could in particular be utilised as an integrated wheel suspension unit with functions primarily for steering, and preferably also for propulsion and braking, of each individual vehicle wheel. This is achieved by means of an arrangement, the characteristics of which are disclosed in the accompanying claim 1.

The invention constitutes an arrangement for an automotive vehicle wheel suspension, in which the wheel is connected to a propulsion device for driving the vehicle, and to a braking device for braking of the individual wheel. The invention comprises sensors for detecting at least the angular steering displacement of the vehicle

required by the vehicle driver, and two steering link arms fitted between said body and attachment points in said wheel, positioned on both sides of an imaginary vertical line running through the centre of the wheel. Furthermore, the invention comprises a control unit for processing signals from said sensors and actuating said steering link arms for adjustment of said wheel in response to said signals and the current operating state of the vehicle.

Through the invention, a number of advantages are achieved compared to conventional wheel suspension systems. Primarily it should be noted that the invention constitutes a highly integrated wheel suspension arrangement, allowing individual adjustment of steering displacement and wheel alignment of the respective wheels of a vehicle. In this way, an individual steering of each wheel of the vehicle in question is allowed. Furthermore, a vehicle comprising the arrangement according to the invention can be designed without any conventional steering gear and/or steering column.

The invention is preferably arranged in connection with a computer-based control unit provided with software functions for dynamic adjustment of wheel alignment, in particular the so-called "camber" angle and the so-called "toe-in" angle of the respective wheel. In this manner a vehicle constructed according to the invention can be designed without any conventional mechanical wheel alignment possibilities.

Furthermore, a vehicle equipped with the arrangement according to the invention may comprise a control device of the "joystick" type or similar, replacing a conventional steering-wheel.

According to a preferred embodiment, the invention includes a propulsion device in the form of an electric motor, integrally arranged in the individual wheel. Through this, the vehicle in question can be designed without a conventional combustion engine, as well as without a conventional gearbox or any drive shaft connecting the individual wheel with a propulsion device fitted on the chassis of the vehicle. Nor do any mechanical connections have to be fitted at the factory, which in turn creates prerequisites for a simple and cost-effective production.

According to the preferred embodiment, a braking device is provided, which is integrated into said electrical motor. In this manner, a vehicle comprising the arrangement according to the invention will not require any conventional drum or disc brake arrangement.

According to the embodiment there is, besides this, a further link arm connected between the respective wheel and the vehicle body, said link arm being provided with a torsion spring unit for controlling a level adjustment of the wheel and for an anti-roll function of the wheel. In this way an advantage is achieved, as the vehicle does not require the provision of any conventional, mechanical anti-roll bar.

Advantageous embodiments of the invention are characterised in the subsequent dependent claims.

DESCRIPTION OF DRAWINGS

The invention will be described in further detail below, with reference to a preferred embodiment example and the appended drawings, in which:

Fig. 1 shows a principle side view, in partial cross-section, of an arrangement according to the present invention,

Fig. 2 shows a perspective view of how the arrangement according to the invention could be arranged in practice on a vehicle, and

Fig. 3 shows the structure of the invention in the form of a block diagram.

PREFERRED EMBODIMENT

Fig. 1 shows a side view, in partial cross-section, of an arrangement according to the present invention. According to a preferred embodiment, the arrangement is utilised as a wheel suspension unit for an automotive vehicle, which may preferably, but not necessarily, consist of a passenger car. The figure shows, in principle, how this wheel suspension unit according to the invention could be arranged at one of the four wheels of such a vehicle. Corresponding wheel suspension units would then preferably be provided for all wheels of the vehicle in question.

According to what can be gathered from Fig. 1, the wheel 1 in question is, in a conventional manner, arranged for rotation about an imaginary axis 2, and comprises a

tire 3 and a hub 4. The hub is rotationally suspended by means of a wheel bearing comprising an inner ring 5, which in turn is connected to the hub 4 via a flange 6, extending radially in relation to said axis 2. In a manner as such known, a number of (not shown) wheel studs may be inserted through the flange 6 and be screwed tight into corresponding (not shown) holes in a surface of the inner ring 5, facing the flange 6. To this end, the flange 6 of the hub 4 is provided with (not shown) threaded holes for such wheel studs.

The wheel bearing mentioned above also comprises an outer ring 7 extending around the inner ring 5, and bearing balls 8 arranged between the inner ring 5 and the outer ring 7.

According to the embodiment, the invention comprises a propulsion device integrated into the wheel 1, preferably consisting of an electric motor 9. The motor 9 in turn comprises an armature 10, provided with (not shown) motor coils, and fixedly attached to the outer ring 7. The motor 9 further comprises a rotor 11, enclosed by the armature 10. The rotor 11 functions to rotate in relation to the outer ring 7 of the wheel bearing, the outer ring 7 thereby being stationary. To this end, the outer ring 7 is designed like an annular sun gear, more precisely having external teeth meshing with a multitude of planetary gears 12 arranged around the circumference of the outer ring 7. The number of planetary gears 12 is preferably three, of which two can be seen in Fig. 1.

Fig. 1 illustrates the invention in principle, and in a somewhat simplified form. In practice, the armature 10 should be connected to a separate component in the form of a (not shown) hub carrier, which would then be bolted to the armature 10.

The planetary gears 12 should be located around the outer ring 7 at substantially the same pitch diameter as the above-mentioned wheel studs. Furthermore, each planetary gear 12 is rotationally supported on a planet carrier stud 13 impacted into a hole in the hub flange 6. To this end, the inner ring 5 of the wheel bearing is provided with through holes for passage of the respective planet carrier stud 13.